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CITATION:

IKENO, Jun. Intra- and Inter-Sectorial Competition for Water Resources around Mwanga Town in Kilimanjaro Region, Tanzania. African study monographs. Supplementary issue 2018, 55: 101-118

ISSUE DATE:

2018-03

URL:

https://doi.org/10.14989/230166

INTRA- AND INTER-SECTORIAL COMPETITION FOR WATER RESOURCES AROUND MWANGA TOWN IN KILIMANJARO REGION, TANZANIA

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ABSTRACT Economic development in Tanzania since the 2000s has revitalized local economies, especially those of small towns and their suburbs. Under such socio-economic transformation, development activities have come to compete with each other. Here, I examine the competition for water resources in and near a small town in northeastern Tanzania since the 2000s. The cases of such competition I present here, which I have collected through my fieldwork, are classified into three categories: competition within the agricultural sector, competition within the public service sector, and competition between the different sectors. Although official development projects and local initiatives are conducted with good intentions, conflict between stakeholders has arisen due to the relative scarcity of water resources. The conflicts and quarrels discussed here are currently not serious, but before a serious conflict does arise, a grand design for the water use and a mediation system to settle problems should be established.

Key Words: Water Use; Irrigation; Piped Water Supply; Urbanization; Mwanga.

INTRODUCTION

At the macro level, the Tanzanian economy has grown rapidly since 2000. Compared with previous development trends, especially those in large urban areas after independence, the current development trend has had a huge impact on the revitalization of local economies. Evidence of this development, such as construction booms and the modernization or rehabilitation of parts of the infrastructure such as roads, water pipes, dispensaries, and schools, can be seen around small towns and their suburbs. In addition, the population of small towns is increasing, and the percentage of the population living in urban areas continues to increase. According to the population census, since independence, the number of urban areas has increased from 32 in 1967 to approximately 600 in 2012; the urban population has increased from 685,092 to 12,701,238; and the urban population ratio has increased from 5.7% to 29.1% (Wenban-Smith, 2014: 5, 7). Even though these figures include data for mega-cities, emerging small towns make a marked contribution. Under such dynamic changes, provision of public services has become a main focal point of urban development. At the same time, the weak industrial bases of small towns, which are still largely centers of administration and consumption, mean that further agricultural development is needed to provide sources of income for residents. Under such conditions, the supply of water for domestic and agricultural uses is becoming an important issue.

Water resources in Tanzania have been investigated by several scholars at var-

ious spatial levels from the viewpoint of hydropolitics (Calas & Martinon, 2010). From a natural science viewpoint, Ngana (2001), Kiptala (2016) and Msuya & Lalika (2017) have analyzed water resources as a system in the Pangani River Basin, which covers a large part of northeastern Tanzania. From a social science standpoint, Komakech et al. (2012) have investigated the competition of water between agriculture and cities, and Lerise (2005) has discussed conflicts over land and water in the Lower Moshi Irrigation Project at the foot of Mt. Kilimanjaro. To add to this previous research, here I present several cases of intra- and inter-sectorial competition for water resources that I collected during field surveys I conducted in and around Mwanga Town, a small, urbanized area within the Pangani River Basin area in northeastern Tanzania.

OVERVIEW OF THE RESEARCH SITE

Mwanga Town (officially Mwanga Small Township) is the capital of Mwanga District, one of seven districts comprising Kilimanjaro Region, northeastern Tanzania (Fig. 1). Two-thirds of the district's 2,641 km^2 of territory is located in the Western and Eastern Plains (1,833 km^2 in total), which is a hot, dry area. The North Pare Mountains (808 km^2) running north to south, which has several summits over 2,000 m above sea level, is an Arabica coffee production zone with a cooler temperature and more rainfall than in the Western and Eastern Plains (Photo 1). There are two water bodies in Mwanga District. On the international border with Kenya is Lake Jipe, a natural lake that collects water flows from Mt. Kilimanjaro (5,895 m above sea level). The water from Lake Jipe then flows into the artificial reservoir of the Nyumba ya Mungu Dam, which was built upstream on Pangani River for the purpose of hydro-electric power generation in the middle of 1960s.

The total population of Mwanga District was 131,442 in 2012. Around one-tenth of the population resides in Mwanga Town (Tanzania, 2013), which is located in the Western Plain. The population of Mwanga Town was 3,540 in 1978; 7,277 in 1988; 12,329 in 2002; and 15,783 in 2012 (Ikeno, 2010; Tanzania, 2013a). The population growth rate of Mwanga Town is one of the highest in the district. Mwanga Town was expanded in the early 1990s by absorbing neighboring Kisangiro Village in the north and Kiruru Lwami Village in the south. The landscape of these former villages has not changed since they were absorbed into the town and they remain as purely farming areas.

The competition for water resources within and near Mwanga Town since the 2000s can be classified into three categories:

A) Competition for water for irrigation (intra-sectorial competition within the agriculture sector).

B) Competition for water for domestic use (intra-sectorial competition within the public service sector).

C) Inter-sectorial competition (competition for water resources between the two sectors).

The cases presented below provide examples of conflicts that fall into these

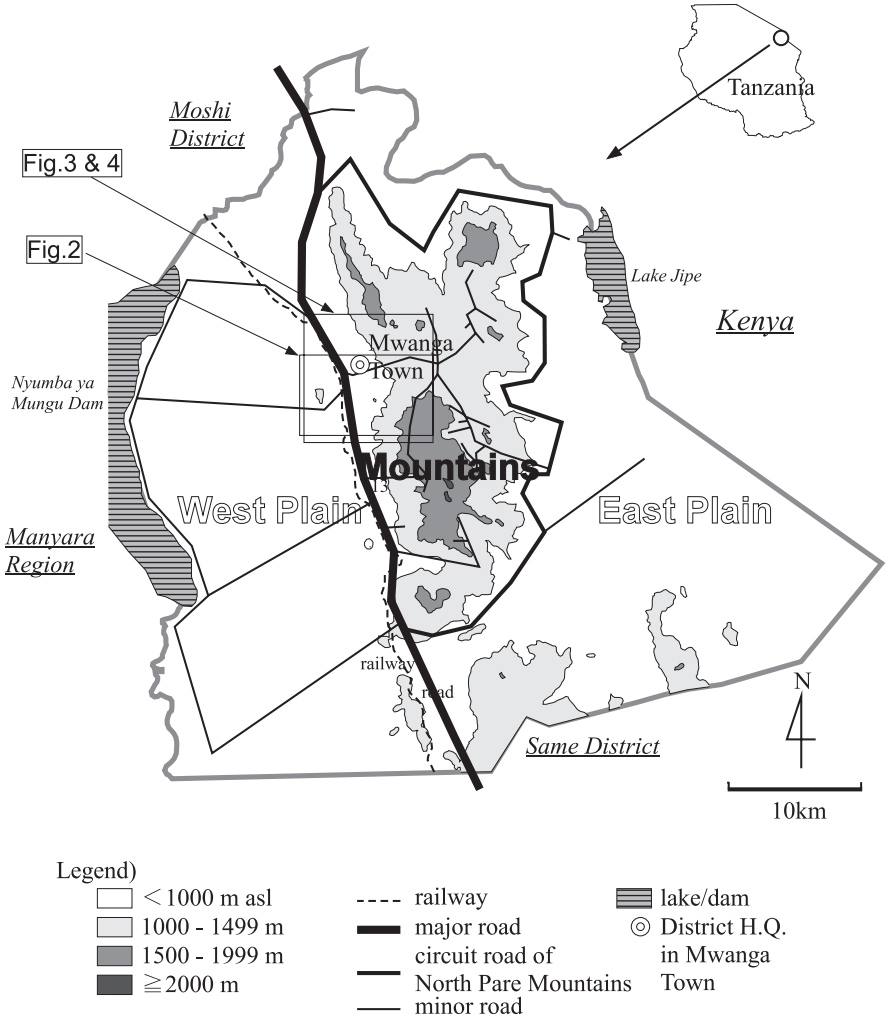

Fig. 1. Map of Mwanga District.
Source) Ikeno (2007: 13).

three categories. Some of these conflicts have been already solved, some are ongoing whether the stakeholders recognize it or not, and others remain unrealized.

INTRA-SECTORIAL COMPETITION WITHIN THE AGRICULTURAL SECTOR

The agricultural fields adjacent to Kirisi hamlet within Vudoi Sub-village (a minimum formal administrative unit) of former Kiruru Lwami Village were used for irrigation farming of common beans in the dry season (July–October), which has been one of my study interests since 1995 (Fig. 2 & Photo 2). Farmers used

to manipulate small water reservoirs called *ndiva* in the Pare language built on the western slope of the North Pare Mountains. They would allow water to collect in the *ndiva* and when full then they would open the gate and the water would flow through furrows and irrigate the land, usually for 4 to 6 hours. After the *ndiva* was empty, the next-day's user would close the gate and water would begin to be collected for use the next day. After more than 15 years from the early 1990s, irrigation farming was abandoned in 2007. The main reason for this was a shift to more profitable emerging activities (Ikeno, 2011; 2016); however, the farmers also complained that there was insufficient water supply for irrigation. This incident is a typical example of increasing competition for a water resource.

Fig. 2 shows the main *ndiva*s built on or near Mbogho Valley, Msogho Valley, and Bokwa River. There are several piped water intakes located within the territories of two mountain villages—Mkuu Village and Vuchama Ndambwe Village. The Pare people, who are the main residents in this district, have a history of irrigation farming in the mountains since before colonialism started in the 1880s (Kimambo, 1991). Table 1 is a list of the *ndiva*s on Mbogho and Msogho valleys (#1–20) and the piped water intakes (A–H) that are shown in Fig. 2. More than one *ndiva* is constructed on the same tributary. During the long dry-season (late June–early November), there is little water flow, even upstream, and no water flow is observed near Kirisi hamlet. The water sources of most *ndiva*s are springs,

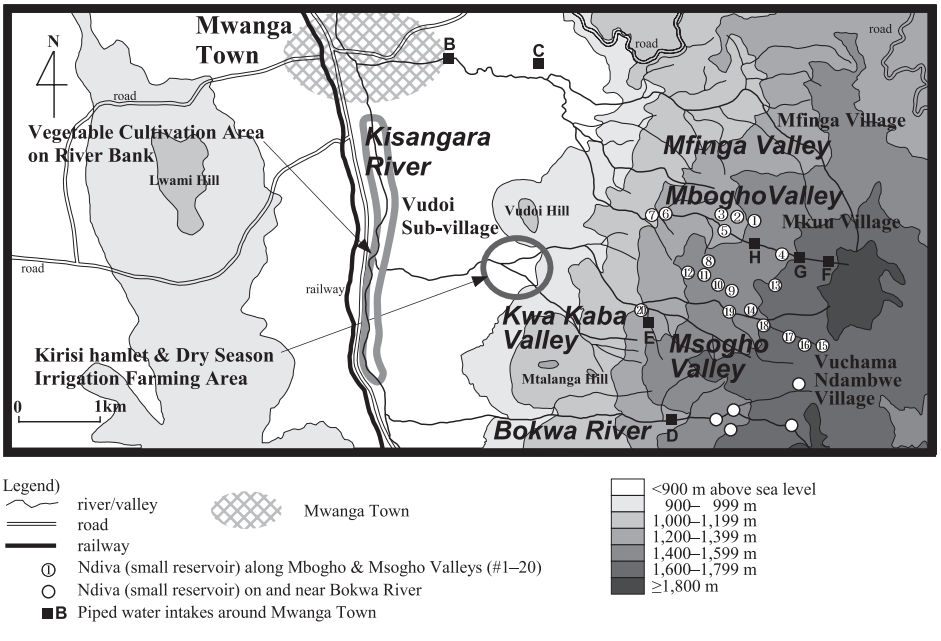

Fig. 2. Main *Ndiva*s and water supply intakes along Mbogho Valley, Msogho Valley and Bokwa River.
Source) Ikeno (2011: 61).
Note) Piped water intake 'A' is not shown due to out of the range of Fig. 2.

Table 1. Main *ndiva*s and piped water intakes around Mbogho and Msogho Valley with addition of piped water intakes at other places around Mwanga Town

Location		*Ndiva* for irrigation[1)2)3)]		Intake for piped water supply[1)]	
				end user	
On or near Mbogho Valley					
tributary 1					
	upper	#1			
		#2			
	lower	#3			
tributary 2					
	upper			F	Households in Mkuu Village
				G	A secondary school (Mkuu Village)
		#4	o		
				H	Households in Mkuu Village
		#5			
		#6			
	lower	#7	*		
In between Mbogho and Msogho Valleys					
	upper	#8			
		#9			
		#10			
		#11	*		
		#12	*		
		#13	o		
	lower	#14			
On or near Msogho Valley					
tributary 1					
	upper	#15	o		
		#16			
		#17	o		
		#18	o		
	lower	#19	*		
tributary 2					
				E	Households in Vudoi Sub-village (Mwanga Town)
downstream of tributary 1 & 2					
		#20	*		
Other piped water intakes					
				A	Northen part of Mwanga Town
				B	Mwanga Town (installed in 2013)
				C	Mwanga Town (installed in 2015)
				D	Southern part of Mwanga Town, etc.

Source) Author's field survey.
Note) 1) Numbers and letters are same as in Fig. 2, 3 and 4.
2) *Ndiva*s with * were used for the dry season irrigation farming in Kirisi.
3) *Ndiva*s with o were improved by Traditional Irrigation Improvement Project.

which provide underground water from the North Pare Mountains reserved during the rainy seasons, and/or water from upstream *ndiva*. Out of 20 *ndiva*s, five downstream *ndiva*s are used for irrigation during the dry season at fields adjacent to Kirisi hamlet. There are also five modernized *ndiva*s, which are discussed in detail later.

Usually, upstream water users have an advantage over downstream users; therefore, some level of cooperation between these two groups is needed. Lack of such cooperation or changes in the preconditions for cooperation can result in conflict.

Case 1: Changing Agricultural Activity in the North Pare Mountains

In the 1990s to early 2000s, coffee producers in the North Pare Mountains were greatly affected by liberalization of the coffee market in Tanzania and the global coffee crisis. The annual production of coffee in Mwanga District fell from 736 tons in 1982/83 to only 16 tons in 2008/09 (Ikeno, 2010), and thereafter did not markedly recover. Under such adverse economic conditions, the mountain farmers shifted from producing coffee to producing other crops, particularly vegetables and fruits. Farmers in Mkuu and Vuchama Ndambwe villages, both of which are in the hinterland of Mwanga Town (Fig. 2), followed suit. Therefore, they started to more frequently use the upstream *ndiva*s on or near Mbogho and Msogho valleys. This meant that the water supply reaching the downstream *ndiva*s that were used for dry-season irrigation in Kirisi (#7, #11, #12, #19, and #20 in Fig. 2 and Table 1) became limited. The result of negotiations had been that from July to September the farmers in Kirisi and the farmers in the mountain users would be able to use the water on alternate weeks. When the downstream *ndiva*s were used, the water gates of the upstream *ndiva*s were left open closed so water could flow into the downstream *ndiva*s. However, increasing vegetable production in the mountains meant that the upstream water gates started to be closed everyday, which meant that less water was available for irrigation in Kirisi.

Despite the situation, a serious conflict between the farmers in Kirisi and those in the mountains did not develop. One reason is that the Kirisi people sympathized with the economic adversity of the mountain people, and allowed them to use all of the water. Also, when the farmers in Kirisi started dry-season farming around 1990, the mountain people agreed to share the water in the *ndiva*s. Moreover, there are complicated kin and affine relations between the people in Kirisi and those in the mountains, which underlies this sympathetic response.

A more positive reason for the abandonment of irrigation farming is that the Kirisi people found more profitable activities than irrigation farming to engage in such as making and selling construction materials (gravel and burnt brick) (Ikeno, 2011; 2016). Therefore, as the farmers in Kirisi moved out voluntarily, the competition for water resolved itself without conflict.

Case 2: Improvement of *Ndiva*

In the 1990s and early 2000s, the Traditional Irrigation Improvement Project (TIP), which was supported by the SNV Netherlands Development Organisation,

tried to enlarge the water reservation capacity of the traditional *ndiva* (#4, #13, #15, #17, and #18 in Fig. 2 and Table 1) on or near Mbogho and Msogho valleys by adding cement-lined walls. However, this meant that the amount of water reaching downstream *ndiva* on or near the same tributary was markedly reduced when the upstream *ndiva* increased their reservation capacity. But this competition was not between the Kirisi and the mountain people, it was between the downstream and upstream mountain people that use the *ndiva*s.

Ironically, most "modern" *ndiva*s have become unusable by 2017 (Photo 3). One possible reason for this was overcapacity from the viewpoint of the management and technology, than the local community could operate. There were no serious conflicts between the upstream users of the improved *ndiva* and the downstream users because both parties recognized that the improvement of *ndiva* was not the responsibility of the upstream people. Moreover, use of the downstream *ndiva* was able to be revived after the improved *ndiva* fell into disuse. Thus, this conflict resolved itself as the improved *ndiva* fell into disuse.

Case 3: Combination of Causes

Case 3 is a combination of Cases 1 and 2. It happened at *ndiva* #18 (Fig. 2 and Table 1), which is an improved *ndiva*. There are also two improved *ndiva*s further upstream (#15 and #17). The users of *ndiva* #17 expanded vegetable cultivation and so they built a new *ndiva* (#16) to collect more water for their agricultural activities. Although the leader of the users of this *ndiva* was respected by the villagers, he took a rather aggressive approach to introducing new crops and agricultural activities. The expansion of vegetable production by using water from *ndiva* #17 produced a severe water shortage at *ndiva* #18, until it was eventually abandoned. In my field research, I heard that a serious conflict arose between the users of *ndiva* #17 and those of #18, and that the village government failed to resolve the conflict. The group of users and the strong leader continue to enjoy the water supply from #17. At the time of writing, this conflict was ongoing but it has been reported to the district authority by the village government.

Case 4: Increasing Vegetable Production on the River Bank and River Floor of Kisangara River

The demand for vegetables by the increasing number of residents in Mwanga Town produced a boom in the irrigation farming of tomato, cabbage, Chinese cabbage, and African spinach (*mchicha* in Swahili) on the river bank and river floor of Kisangara River, which runs alongside the railway and main tarmac road from Dar es Salaam to Moshi City (Fig. 2). There is no water flow on the river during the dry season; therefore, both the river bank and river floor are used for irrigation farming. Traditionally, wells with a depth of 3–5 m were dug at the sides of fields, and buckets of water were carried from the wells for irrigation. Recently, however, some farmers have introduced small diesel pumps to pump water from the wells (Photo 4). In addition, there is at least one farmer who has made a large water reserve pool for his own use.

The competition for water among the vegetable farmers in the Western Plain near Mwanga Town is not yet recognized by the farmers themselves. Although some people envy the farmers who are using small pumps to improve their new agricultural business, no serious conflict has yet occurred.

INTRA-SECTORIAL COMPETITION WITHIN THE PUBLIC SERVICE SECTOR

Mwanga Town has a chronic piped-water shortage problem. Hawkers selling water in 20-liter plastic containers have long been a common scene. Therefore, the security of the piped water supply service is an important concern for the Mwanga Urban Water Supply Authority (MWANGUWASA. *Mamlaka ya Maji Mwanga* in Swahili).

Fig. 3 shows the piped water supply system in or near Mwanga Town, and Fig. 4 is a flowchart of the water supply routes within the piped water supply system. The former main water source to the center of Mwanga Town (hereafter Mwanga downtown) is 'D' (Figs. 3 and 4) on Bokwa River in neighboring Kiruru Ibweijewa Village. Water from 'D' was kept in tank 'd1' (reserve capacity, 90 m^3) in a suburb of Mwanga Town. There were three water supply routes from tank 'd1'. The first one was a large-diameter pipe to tank 'c' (two tanks. reserve capacity, 225 m^3 each) in Vudoi Hill adjacent to Kirisi hamlet. The second one was a medium-diameter pipe to tank 'd2' (reserve capacity, 225 m^3) on the hill in neighboring Kiruru Ibweijewa Village and the third small-diameter pipe was to end-users in the southern part of Mwanga Town, which was located in former Kiruru Lwami Village. The water in tank 'c' goes to Mwanga downtown and the Reli Juu area of the town beyond the main road. Water from tank 'd2' is used by households in Kiruru Ibweijewa Village and it is also used to fill tank 'd3' (reserve capacity, 22.5 m^3), which supplies the western end of Mwanga Town.

The nearby mountain village, Mkuu Village, is also connected to the piped water supply. Intake 'F' is connected to a small water reserve tank and is the main water source for households in that village (Photo 5). There are at least two other intakes ('G' and 'H'), with 'G' being the water source for a newly established secondary school.

Case 5: Competition for Water between Mwanga Downtown and Other Areas

There was competition for water from tank 'd1', mainly between Mwanga downtown (via tank 'c') and users of the other two pipelines. Because of the scarcity of water supply from 'D', the three pipes from tank 'd1' could not be opened simultaneously. Usually the water supply to the more populated Mwanga downtown had priority, and people depending on other pipelines experienced frequent cut-offs. This problem was settled in 2017 because Mwanga downtown stopped depending on the water supply (route #6 in Fig. 4) from intake 'D'.

Even though Mwanga downtown was provided water first, the amount of water supply from 'D' was not enough. Therefore, MWANGUWASA decided to stop using water from 'D' and developed alternative water sources within Mwanga

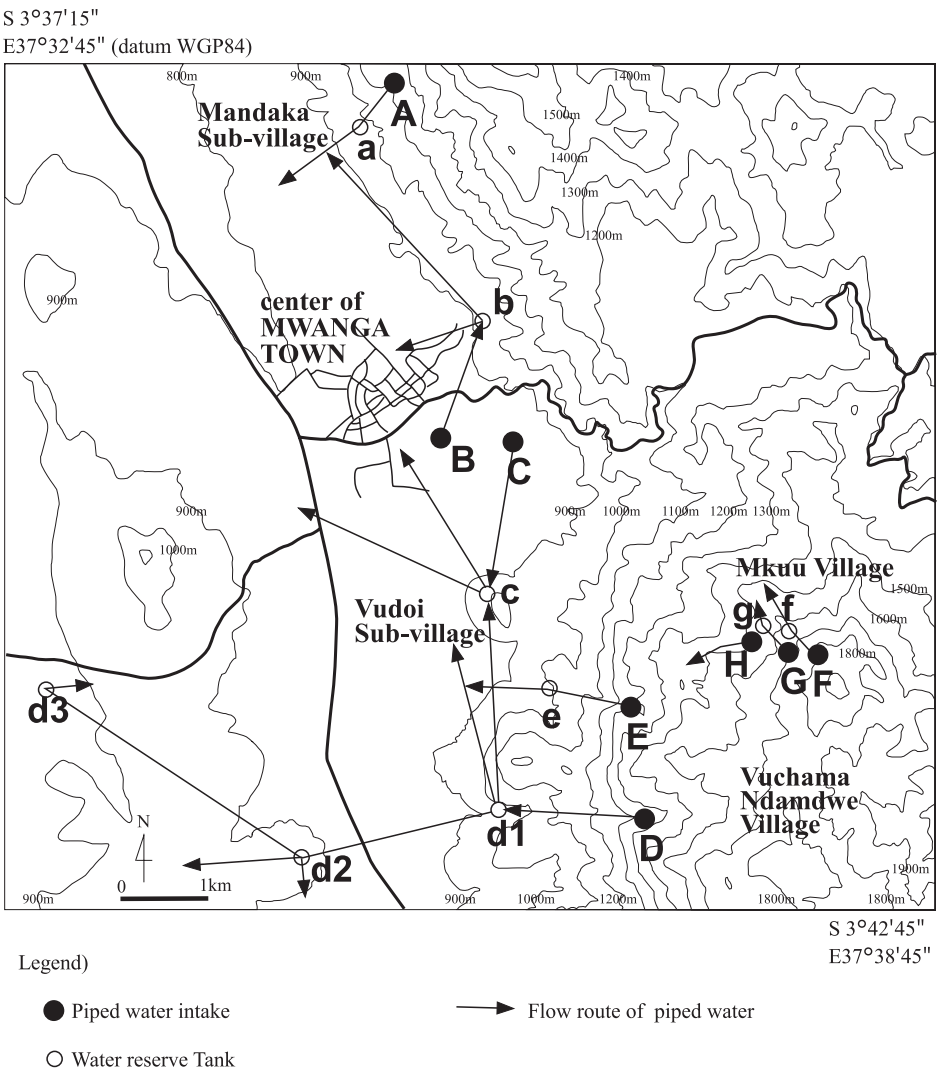

Fig. 3. Intakes and water reserve tanks for piped water service around Mwanga Town. Source) Author's fieldwork.

Town administrative area ('B' and 'C'). Thereafter, tank 'c' started to receive water from a pump-up borehole ('C') and in an emergency from a second pump-up borehole ('B'), both of which are located near Mwanga downtown. The water pumped at 'B' usually goes to tank 'b' (135 m^3), then to the northern part of Mwanga Town and part of Mwanga downtown. The northern part of Mwanga Town, which is the former Kisangiro Village, has its own intake, 'A', and tank, 'a' (reserve capacity, 90 m^3). However, both of these are unreliable; therefore, households and the secondary school in the area now use the water from 'B'.

After establishing a water supply from the pump-up boreholes to tank 'c',

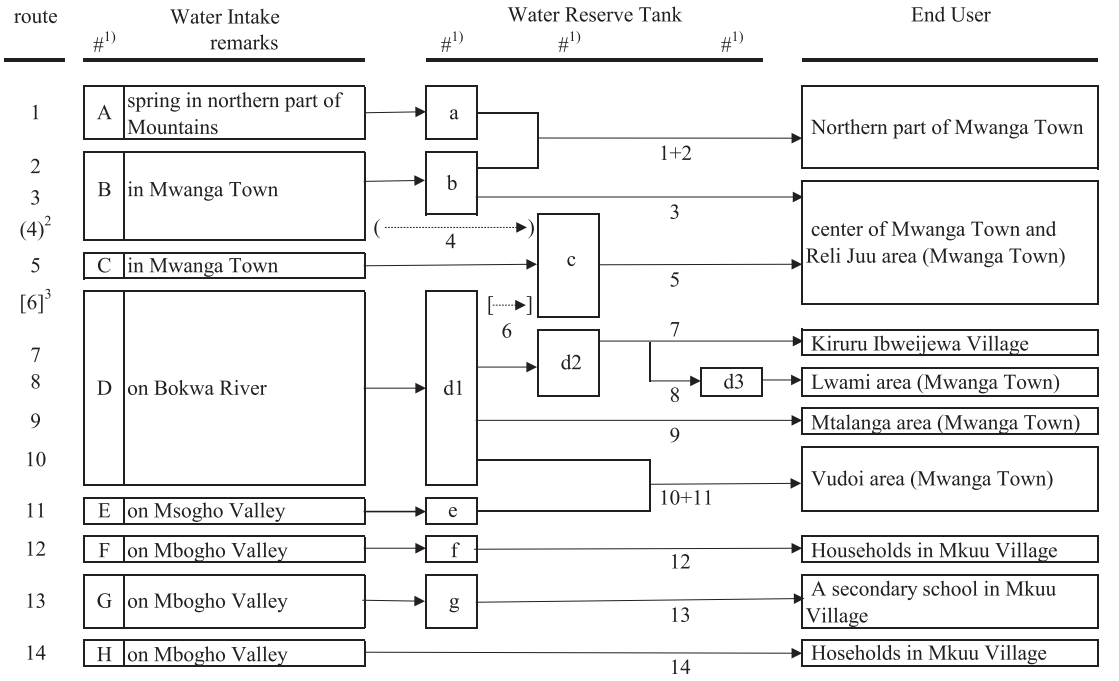

Fig. 4. Flowchart of piped water systems around Mwanga Town.
Source) Author's filed survey and data provided by Mwanga Urban Water Supply Authority on 25 Aug. 2017.
Note) 1) Numbers and letters are same as in Table 1, Fig. 2 and 3.
2) Route 4 is used only in emergency.
3) Route 6 has already closed by 2017.

another two pipelines became unable to get enough water from intake ‘D’ via tank ‘d1’ because of the upstream water use on Bokwa River (Fig. 2) mentioned below as part of Case 8.

As MWANGUWASA developed new water sources, the competition between Mwanga downtown and the other area for the water supply has stopped. However, Mwanga downtown had no water supply during the middle of August 2017 due to disruption of power to the pumps for ‘B’ and ‘C’, possibly because the authority did not pay the electric power company. Thus, the water problems in Mwanga downtown and other areas are still unreliable.

Case 6: Competition among Water Users of the Kwa Tugha Water Supply Project

Frequent disruption of the water supply was one of the main reasons why the people in Vudoi Sub-village launched the Kwa Tugha Water Supply Project in 2003, which uses an intake (‘E’ in Figs. 3 and 4) on the Kwa Tugha tributary of Msogho Valley that is joined to the pipe from tank ‘d1’. In the initial stage of the project, there were not enough money to purchase the materials needed. Therefore, one newly established girls’ secondary school that needed a water supply supported the project by installing a water reserve tank ‘e’. Since 2009, the water supply established by the project has worked well under a rotation system—one day for Kirisi hamlet and the next for Mramba hamlet, another hamlet in Vudoi Sub-village.

Recently, many households have built round cement-lined water containers (diameter, 1.5–2 m; height, 1.2–1.5 m) to avoid the inconvenience of having no water supply every two days (Photo 6). However, when the upstream households started to keep water in their containers, the downstream households had no water supply, and this became the cause of squabbles.

A similar problem was caused by the brick-making industry. In the first stage of making burnt brick, clay soil must be mixed with a large amount of water. When households upstream started to make burnt brick, this limited the water supply reaching the households downstream, which caused a conflict to arise. This is an example of a business activity affecting a domestic water supply.

Furthermore, water reserve tank ‘e’ collapsed. The girls’ secondary school doesn’t intend to donate again because the school had its own well within their premise and therefore no longer depended on the water supply of the Kwa Tugha Project. This also meant that the water flow from intake ‘E’ continued without any facility to buffer fluctuations in the flow.

Here, a successful local initiative to improve the water supply in the local area was conducted without substantial official support. However, it also created distrust among the local people in Vudoi Sub-village. This case is ongoing.

Case 7: Mushrooming of New Secondary Schools

In the early 2000s, the Tanzanian government started to promote secondary education under its Poverty Reduction Strategy, which was a new national development policy following the Structural Adjustment Program (SAP) in the 1980s

and 1990s. In the SAP, cost-sharing for the education and health sectors was a burden to beneficiaries of these public services. As a result, in the education sector, primary-school enrollment decreased drastically. However, since the 2000s, the Tanzanian government has restarted promoting the education sector, in particular secondary education. To this end, local governments were ordered to build one government secondary school in each ward (*kata* in Swahili), which is an administrative unit comprising several villages. Thus, the founding of new secondary schools not only by local governments but also by the private sector began.

Fig. 5 shows the locations of secondary schools, and Table 2 shows data describing the secondary schools in or near Mwanga Town as of 2017. Out of the 10 schools, 8 were newly registered after 2000. It is noteworthy that all 10 schools

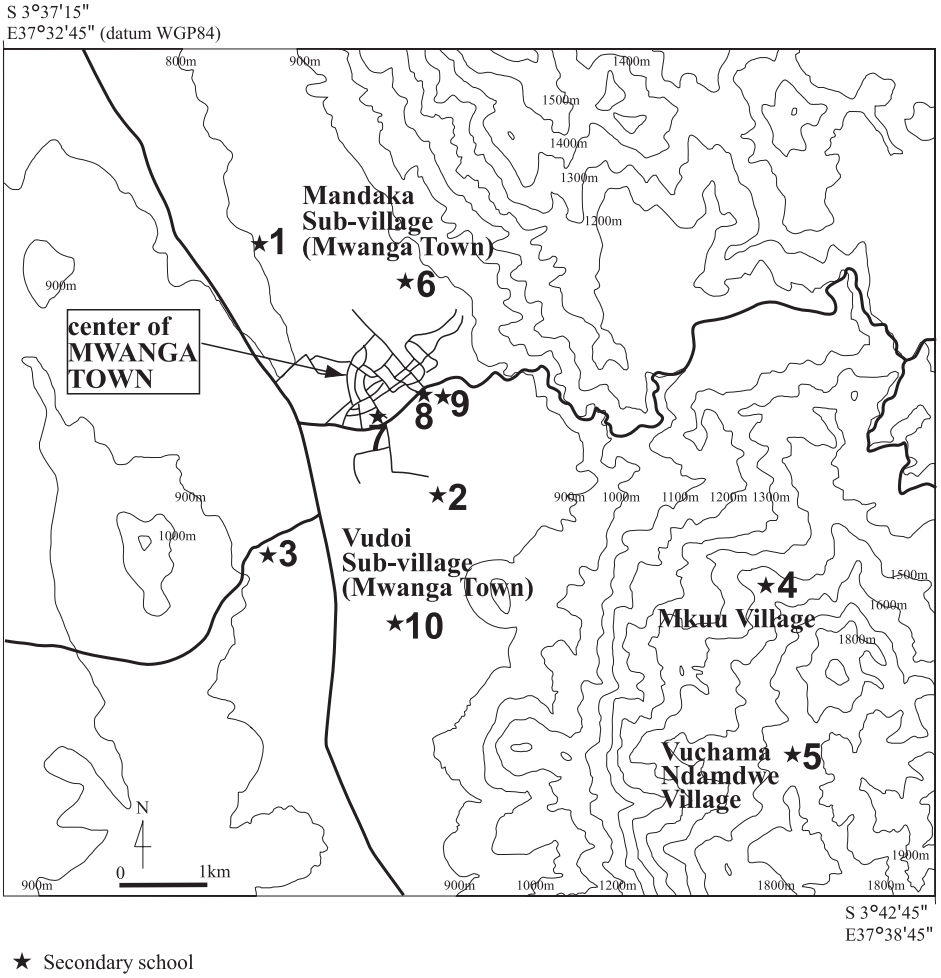

Fig. 5. Locations of secondary schools around Mwanga Town.
Source) Author's field survey.
Note) Numbers are same as Table 2.

Table 2. List of Secondary Schools[1)] around Mwanga Town in 2017

#[2)]	location	founder	year of registration[3)]	number of students (2017)			type	water sources					
				boy	girl	total	day/ boarding[4)]	piped water	furrow	bore-hole	reser-voir	rain	other
1	Mwanga Town	Government	2006	243	250	493	both	○				○	
2	Mwanga Town	Government	1995	571	413	984	both	○					
3	Mwanga Town	Government	2010		287	287	both	○		○			○
4	Mkuu Village	Government	2004	212	225	437	both	○					
5	V. Ndambwe Village	Government	2004	244	7	251	both						○
6	Mwanga Town	Christian mission	2014		205	205	boarding	○					
7	Mwanga Town	Local society	1987	337	215	552	boarding	○					
8	Mwanga Town	Private	2001		171	171	boarding	○		○			
9	Mwanga Town	Private	2010	138		138	boarding	○		○			
10	Mwanga Town	Christian mission	2008		400	400	boarding			○			

Source) Data provided by the Department of Education (Secondary) of Mwanga District on 22 Aug. 2017 and some modification based on data provided by Mwanga Urban Water Supply Authority on 25 Aug. 2017.

Note) 1) There are other educational institutions which have boarding facilities such as Kiliarumo Agriculture & Livestock College, Green Bird College, a school for the disables and some private primary schools.
2) Numbers are same as in Fig. 5.
3) The year of registration seems to be different from the year of establishment, especially those established earlier than 2000.
4) Number of students classified into day or boarding is not available.

provide boarding facilities, which means they have a huge demand for water for domestic use, which potentially competes with the demand of private households. Actually 7 secondary schools (#1, #2, #3, #6, #7, #8, and #9 in Table 2) depend on the same piped water supply systems as for the private households with exception of one school (#4) which has its own piped water supply system. To solve such problems, some schools have boreholes within their premises (#3, #8, #9, and #10). Moreover, at least one school (#10, which is the school that used to support the Kwa Tugha Water Supply Project) provides water to the area at a cheap price. Only one school (#5) does not have any reliable water supply. It is expected that this competition for water between secondary schools and households will continue in the near future.

INTER-SECTORIAL COMPETITIONS

I have already explained the intra-sectorial competition within the agricultural sector and within the public service sector. Both sectors do not confront the scarcity of water resource independently; therefore, there is competition beyond the boundaries of the sectors.

Case 8: Competition between *Ndiva* and Piped Water Intakes

As shown in Table 1, there are two cases where the piped water intakes and *ndiva* intakes are located on the same tributary.

The first case is tributary 2 in the Mbogho Valley. The piped water intake for households in Mkuu Village ('F') and the intake for a secondary school ('G') take water upperstream than *ndiva*s. This is a potential cause of a shortage of water to *ndiva* #4, which was improved by the TIP, and *ndiva* #7, which was one of the main sources of irrigation water for dry-season irrigation farming in Kirisi; however, there were no serious complaints. One reason for this is that the water users of *ndiva* #4 are also beneficiaries of the piped water supply in Mkuu Village. In addition, the Kirisi people do not need the water from *ndiva* #7 because they stopped irrigation farming, as discussed in Case 1.

The second case is competition between intake 'E' of the Kwa Tugha Water Supply Project in tributary 2 of Msogho Valley and *ndiva* #20 downstream. Dry-season irrigation ceased in 2007 before the full operation of the Kwa Tugha Water Supply Project in 2009. *Ndiva* #20 was not maintained and is now in disrepair. However, the water users of the piped water supply include residents of Vudoi Sub-village, which includes many dry-season irrigators in Kirisi Hamlet. However, no serious conflict has been observed.

Fig. 2 gives us a third case. Water supply to the intake of piped water 'D' on Bokwa River is limited by several upstream *ndiva*. Negotiations between users of the upstream *ndiva*s and the downstream piped water have not been successful. Mwanga Town has already declined to join the negotiations because it no longer depends on the water from 'D'.

Case 9: Potential Competition among Water Use in and near Mwanga Town and Water Use Downstream of Pangani River

The government ministries that were responsible for the generation of hydro-electric power by Nyumba ya Mungu Dam (Fig. 1) are aware of the need for sufficient water inflow to the artificial reservoir. Recently, they loosened regulations because the establishment of a natural-gas power station in Dar es Salaam has decreased dependence on hydro-electric power. However, water from Nyumba ya Mungu Dam to Pangani River remains an important source of water for irrigation and domestic use by people downstream of Pangani River. Some of the developmental actions, which have already been discussed in this paper (i.e., improvement of traditional *ndiva*, establishment of piped water supply intakes in the mountain villages, enlargement of pump-up facilities in Mwanga Town, construction of pump-up wells on premises of secondary schools, introduction of small pumps for vegetable cultivation on the river bank) have increased water consumption in and near Mwanga Town. Compared with the Mt. Meru and Mt. Kilimanjaro areas, the contribution of the North Pare Mountains in Mwanga District to the water level in the Nyumba ya Mungu Dam reservoir does appear to be that large; however, it is important to note that few data of actual water consumption have been collected (Ngana 2001; Kiptala 2016). Pangani Basin

Water Office, which is responsible for the water distribution of the Pangani basin system has data for the public use of newly installed modern irrigation systems and piped water supply intakes, but not for the pump-up facilities within individual properties (i.e., fields, houses, and schools).

CONCLUSION

Projects for the development of the agricultural and public service sectors, initiated by the government, foreign aid agencies, and/or local people, are essential to improve the lives of the people in the study area. However, in areas where water resources are scarce, development projects often compete with each other, even though some development actions such as 'de-agrarianisation' (Bryceson & Jamal, 1997) might reduce tension over water resources. In this paper, I provide evidence of competition over water sources in or near Mwanga Town, the center of the economic, educational, and administrative activities in Mwanga District, Kilimanjaro Region.

The cases discussed indicate the possibility of competition over water from a social science viewpoint. However, there is no concrete data regarding actual water use in or near Mwanga Town. A natural scientist at a small workshop on vitalizing the local economies in Tanzania with respect to sustainable resource management held at Sokoine University of Agriculture noted the following:

> The visible water use of irrigation for growing vegetables seems to be more than that used for coffee cultivation; however, coffee trees might consume more water from underground reserves than vegetables. Therefore, careful comparison of total water consumption between coffee and vegetable cultivation is needed.

In addition, tree felling and the making of gravel on the western slope of the North Pare Mountains, including the area near Kirisi hamlet, are responsible for environmental degradation that may decrease the water reserve capacity of the land. As a social scientist, I am unable to investigate these issues; therefore, closer collaboration between social scientists and natural scientists is needed.

The main actors in solving water competition issues are the local administrations and the local people themselves. According to the "National Land Use Plan" (NLUPC, 2013b) and "Village Land Act" (Tanzania, 1999), both of which are the present basis of national resource management in Tanzania, the district and the village authorities must prepare land-use plans for their whole district and/or village, including plans for the conservation of water resources and means of mediating conflicts that arise (NLUPC 2006; 2013b). The Pangani Basin Water Office, which acts beyond the district boundaries, also has an important role in controlling the water resources in the Pangani river basin system. With a newly emerging huge water supply project involving the Nyumba ya Mungu Dam, which covers several local towns within the Pangani river basin system including Mwanga, greater reliance on the office's mediation function is expected.

ACKNOWLEDGEMENT I greatly appreciate the Ministry of Education, Science, Sports, Culture and Technology of Japan and the Japan Society for the Promotion of Science to fund our research works for 2013 to 2017 academic years (Grant-in-Aid for Scientific Research Project, No. 25257107 of 2013 headed by Jun IKENO). I also express sincere gratitude to the Tanzania Commission for Science and Technology (COSTECH), Kilimanjaro Regional Office, Mwanga District Office, Mwanga Small Township Office and all residents who are concerned to allow me to conduct researches in the Northern Highlands of Tanzania.

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Accepted *November 30, 2017*

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Photo 1. Distant view of the Western Plain (near Kirisi hamlet) and Nyumba ya Mungu Dam from the Mountains (05/Aug./2014).

Photo 2. Dry season irrigation farming near Kirisi hamlet (05/Aug./2006).

Photo 3. Abandoned *Ndiva* #18 which was improved by TIP (27/Feb./2009).

Photo 4. Small diesel pump and an irrigation field on river bank (14/Aug./2013).

Photo 5. Intake 'F' of piped water supply project in Mkuu Village (19/Aug./2015).

Photo 6. Water container in Kirisi hamlet (21/Aug./2009).